2. BACKGROUND AND OPERATIONAL HISTORY

This section addresses INTEC's general background, mission, and operational history as they pertain to the Tank Farm Facility.

In the 1950s, construction began on INTEC (then called the Chemical Processing Plant [CPP]). Nuclear fuel storage operations began in 1952, and reprocessing of SNF was conducted at INTEC from 1953 to 1992. Tanks within the INTEC tank farm were constructed from 1951 through 1964 and were used to support INTEC SNF reprocessing operations and other incidental liquid waste streams.

2.1 Physical Setting

This section presents only an overview of the INEEL's physiography, ecology, surface hydrology, meteorology, climatology, demography, and land use, because these topics have been addressed at length in past INEEL WAG 3 and WAG 7 CERCLA reports (DOE-ID 1997a, 1997b, 1998b, 1999a, 2003a). However, the latest information on the geology and hydrogeology are discussed in detail in the following sections because of their importance to groundwater movement. The specific INTEC geology/hydrogeology is discussed in Section 4.1 with the hydrogeologic conceptual model. The latest land use defined by DOE Idaho is discussed in Section 5.1.3.

The INEEL Site is located in southeastern Idaho near the northeast end of the Snake River Plain. This plain is a large topographic depression that extends from the Oregon border across Idaho to Yellowstone National Park and northwestern Wyoming (DOE-ID 1998b). The INEEL Site occupies 890 mi^2. It is nearly 39 mi long from north to south and about 36 mi wide in its broadest southern portion. The Lost River Range, the Lemhi Range, and the Beaverhead Mountains border the INEEL on the north and west (see Figure 2-1). The lands that surround the INEEL are managed as rangeland, agricultural lands, U.S. Forest Service lands, and U.S. Bureau of Land Management lands.

The surface of the INEEL is a relatively flat, semiarid, sagebrush desert. Predominant relief is manifested either as volcanic buttes jutting up from the desert floor or as uneven surface expressions of basalt flows or flow vents and fissures. Elevations on the INEEL range from 4,790 ft in the south to 5,913 ft in the northeast, with an average elevation of 5,000 ft above sea level (Irving 1993). The elevation at INTEC, located in the south-central portion of the INEEL, averages 4,917 ft.

In the western portion of the INEEL, intermittently flowing waters from the Big Lost River flow to the Lost River Sinks in the northwest portion of the INEEL. Water either evaporates or infiltrates into the SRPA at the sinks. Normally, water is diverted for irrigation before reaching the INEEL and only flows onto the INEEL Site when sufficient snowpack occurs to provide spring run-off (DOE-ID 1998b).

Meteorological and climatological data for the INEEL and the surrounding region are collected and compiled from several meteorological stations operated by the National Oceanic and Atmospheric Administration field office in Idaho Falls, Idaho. Three stations are located on the INEEL: one at the Central Facilities Area, one at Test Area North, and one at the Radioactive Waste Management Complex (RWMC). Average annual precipitation at the INEEL is 8.7 in., with the highest amounts occurring during the months of May and June and the lowest in July. Normal winter snowfall occurs from November through April, though occasional snowstorms occur in May, June, and October. Annual snowfall at the INEEL ranges from a low of about 6.8 in. to a high of about 59.7 in., and the annual average is 27.6 in. The average summer daytime maximum temperature is 83°F, while the average winter daytime maximum temperature is 31°F (Clawson, Start, and Ricks 1989).

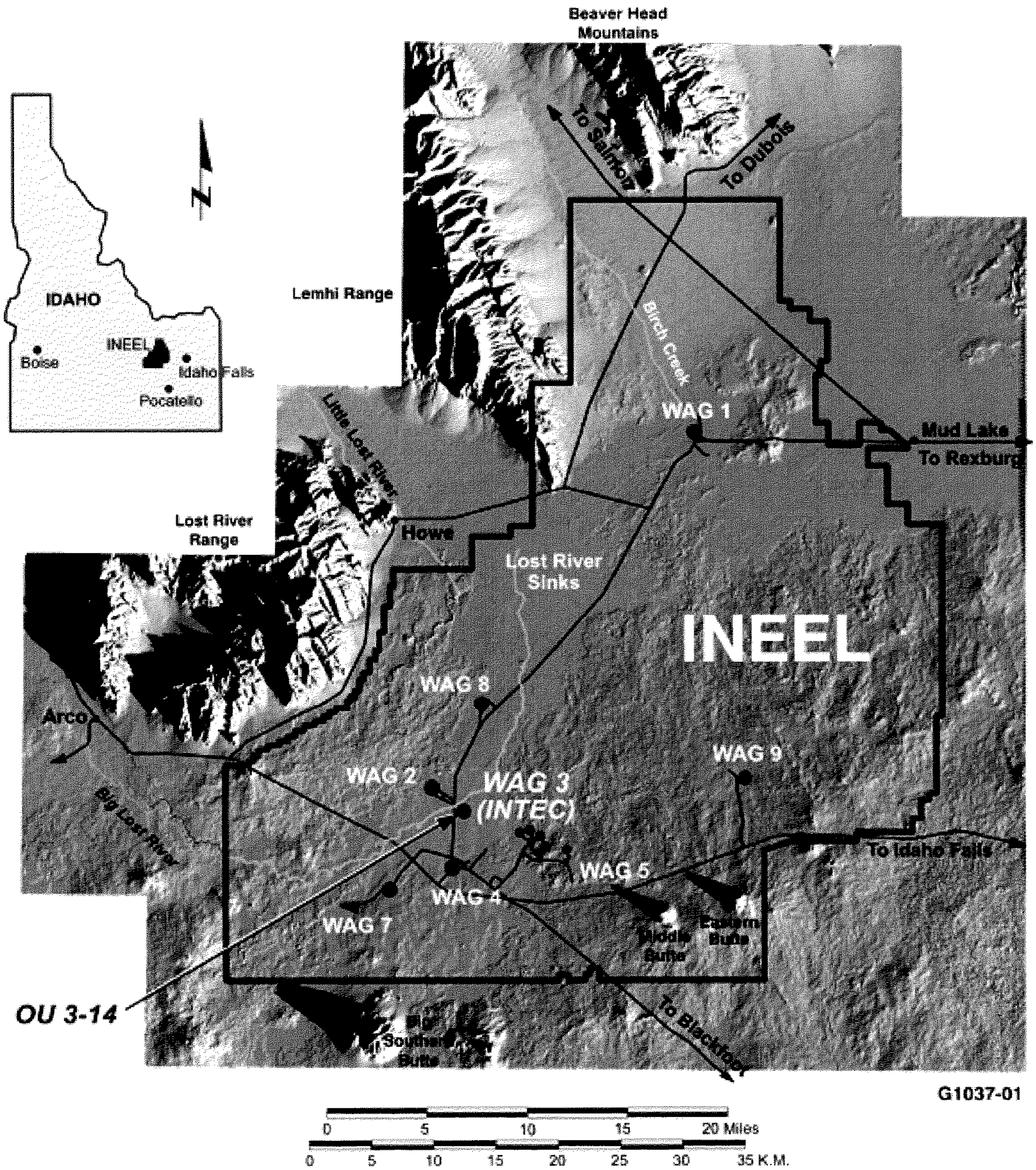

Figure 2-1. Aerial view of the INEEL, showing the bordering mountain ranges.

Regionally, the INEEL is nearest to the major population centers of Idaho Falls and Pocatello and to U.S. Interstate Highways I-15 and I-86. The INEEL Site occupies portions of five southeast Idaho counties: Butte, Bingham, Bonneville, Jefferson, and Clark. Most of the INEEL lies within Butte County. Approximately 95% of the INEEL has been withdrawn from the public domain. The remaining 5% includes public highways (U.S. 20 and 26 and Idaho 22, 28, and 33) and the Experimental Breeder Reactor I, which is a national historic landmark (Irving 1993; DOE-ID 1998b).

2.1.1 INEEL Geology

This section is an overview of the regional geology to aid in understanding the subsurface stratigraphy at INTEC and the features that control the subsurface movement of water in the vadose zone and the SRPA. The complexity of the Eastern Snake River Plain (ESRP) geology necessitates a reasonable understanding of how and why it was formed. Included in this section is a general description of the important components that control the fate and transport of contamination from the tank farm at INTEC.

2.1.1.1 Snake River Plain. The INEEL is located in south-central Idaho on the Snake River Plain. The Snake River Plain is commonly divided into two regions: a western region, which is a northwest-trending depositional basin, and an eastern region, which is a northeast-trending volcanic plain (Malde 1991). The INEEL is located in the eastern region of the Snake River Plain. This volcanic plain is composed of approximately 3,000 ft of layered late-Cenozoic basalt flows over a rhyolitic basement that extends to a depth of 10,000 ft, but its total thickness is unknown (Malde 1991).

The ESRP is approximately 200 mi long and ranges between 50 and 70 mi in width (Anderson 1991). It is bounded on the west by the north-flowing reach of the Snake River through the Hagerman Valley and on the east by the Island Park rhyolite deposits. The northern and southern boundaries consist of the basin and range mountains of south-central Idaho (Malde 1991).

2.1.1.2 Origin of the Snake River Plain Volcanics. The crustal structure of the Snake River Plain volcanics, although not completely understood, is believed to include the entire thickness of the crust that was significantly modified by a subsurface heat source known as the "Yellowstone hot spot" (Malde 1991). The track of the Yellowstone hot spot is represented by a systematic northeast-trending, linear belt of silicic-forming volcanism that arrived at Yellowstone approximately 2 million years ago. The hot-spot-induced vulcanism started about 16 million years ago near the Nevada-Oregon-Idaho border and progressed NE toward Yellowstone at approximately 1.18 in./yr (Pierce and Morgan 1990).

The hot spot caused two types of large-scale melting to occur. The first melting involved the generation of basaltic magmas from hot mantle material that migrated to mid-crustal depths (5 to 12.4 mi). This melting was due to a decrease in pressure as the hot mantle material migrated upward. The second type of melting was due to heating of mid-crustal rocks by the much hotter basaltic magmas that rose from the mantle plume. The melting of mid-crustal rock produced granitic melts that migrated upward to form near-surface reservoirs and caused widespread explosive and effusive rhyolitic volcanism. The melting processes associated with the hot spot created a lens of anomalously dense basalt roughly 6.2 mi thick in the mid-crust. The addition of this weight to the crust, coupled with the material cooling after passing over the hot spot, has caused the ESRP to subside approximately 1.2 mi during the past 4 million years (SAR-II-8.4 2003).

2.1.1.3 Basalt Flow Structure. The ESRP is a product of plains-style volcanism, which is typified by low shield volcanoes located on volcanic rift zones having slopes of about 1-degree dip (Greeley 1982). The shields form in an overlapping manner, with minor fissure-fed flows often filling in low areas between shields, producing a subdued topography. The volcanism in the ESRP has been episodic, emplacing lava flows over relatively short periods (a few hundred to a few thousand years), with long periods of volcanic quiescence (tens of thousands to millions of years). During the quiescent periods, loess, alluvial silt, sand, gravel, and lacustrine clays and silt are deposited on top of the basalt, often in topographic lows.

Two types of basalt are commonly erupted on the ESRP: (1) a form known as *pahoehoe*, which is a very fluid, low-viscosity lava that produces thin tongues and lobes, and (2) *aa*, which is a high-viscosity lava that results in blocky angular flows. A third "hybrid" type of basalt is also found among the lava flows of the ESRP. Malde (1991) suggests that this hybrid basalt was formed by magma interacting with crustal rocks at depths of about 19 mi. As suggested by Greeley (1982), pahoehoe is the dominant type of basalt that erupted on the Snake River Plain and forms the long, low-angle flanks of the low shield volcanoes.

A typical basalt flow can be divided into four layered elements (Knutson et al. 1990). The lowest layer is the substratum, consisting of a ropy pahoehoe surface, fracture and fissured surfaces, and rubble zones (see Figure 2-2). This layer accounts for about 5% of the flow thickness. Above the substratum is a lower vesicular zone that contributes an average of 11% of the flow thickness. Vesicles form by degassing of the lava, and polygonal fracturing is common in this layer. The massive central element, or nonvesicular zone, of the flow composes about 49% of the thickness. The central element is dense, with few fractures except for vertical columnar jointing. The uppermost element of the flow is the upper vesicular element, accounting for about 35% of the thickness of the flow. This element may have a parting parallel to the upper surface as well as fissures and broken basalt.

The saturated hydraulic properties of basalt are very anisotropic. The most important portions of the basalt flow contributing to the horizontal transmission of water for saturated conditions are the rubble zones between basalt flows in which the lower rubble zone from one flow lies on top of the upper vesicular element of the flow beneath it. Layered basalt flows, therefore, have a high horizontal saturated permeability.

Fractures in subsurface basalt lava flows commonly contain fine-grained sediment infilling and fracture wall coatings because of downward percolation from the overlying sediments. The sediment infilling of the fractures should cause a decrease in the permeability of fractured basalt below the interbeds, though the effects of sediment infilling have not been measured. Where the top of a flow has been covered and fractures have been filled with fine-grained sediment, a low-permeability layer can form. The massive central element of a flow can also have very low permeability, depending on the extent of fracturing.

2.1.1.4 Flows, Flow Units, Flow Groups. A basalt flow, commonly referred to as a lava flow, is generally defined as an individual molten body of rock that has been extruded out horizontally across the earth's surface from a fissure or vent. The molten rock subsequently cools and solidifies, resulting in a unique flow that can generally be distinguished from surrounding flows. The term "basalt flow" is used somewhat loosely in the context of ESRP geology to describe individual flows, groups of flows, or flow subsets. In some cases, a basalt flow may refer to a flow group, which is a group of petrographically similar flows that erupted from the same magma chamber (Anderson and Lewis 1989). In other cases, a flow will refer to a separate distinct lobe that issued out from a parent flow.

2.1.2 INEEL Hydrogeology

Subsurface hydrology at the INEEL is discussed as three components: the vadose zone, perched water, and the SRPA. The vadose zone, also referred to as the unsaturated zone, extends from the land surface down to the water table. The water content of the geologic materials in the vadose zone is commonly less than saturation, and water is held under negative pressure. Perched water in the subsurface forms as discontinuous saturated lenses with unsaturated conditions existing both above and below the lenses. Perched water bodies are formed by vertical and, to a lesser extent, lateral migration of water moving away from a source until an impeding sedimentary layer is encountered. The SRPA, also referred to as the saturated zone, occurs at various depths beneath the ESRP. About 9% of the SRPA lies beneath the INEEL (DOE-ID 1996). The depth to the water table ranges from approximately 200 ft in the northern part of the INEEL to more than 900 ft in the southern part (Irving 1993). The SRPA, which consists of basalt and sediments and the groundwater stored in these materials, is one of the largest aquifers in the United States (Irving 1993).

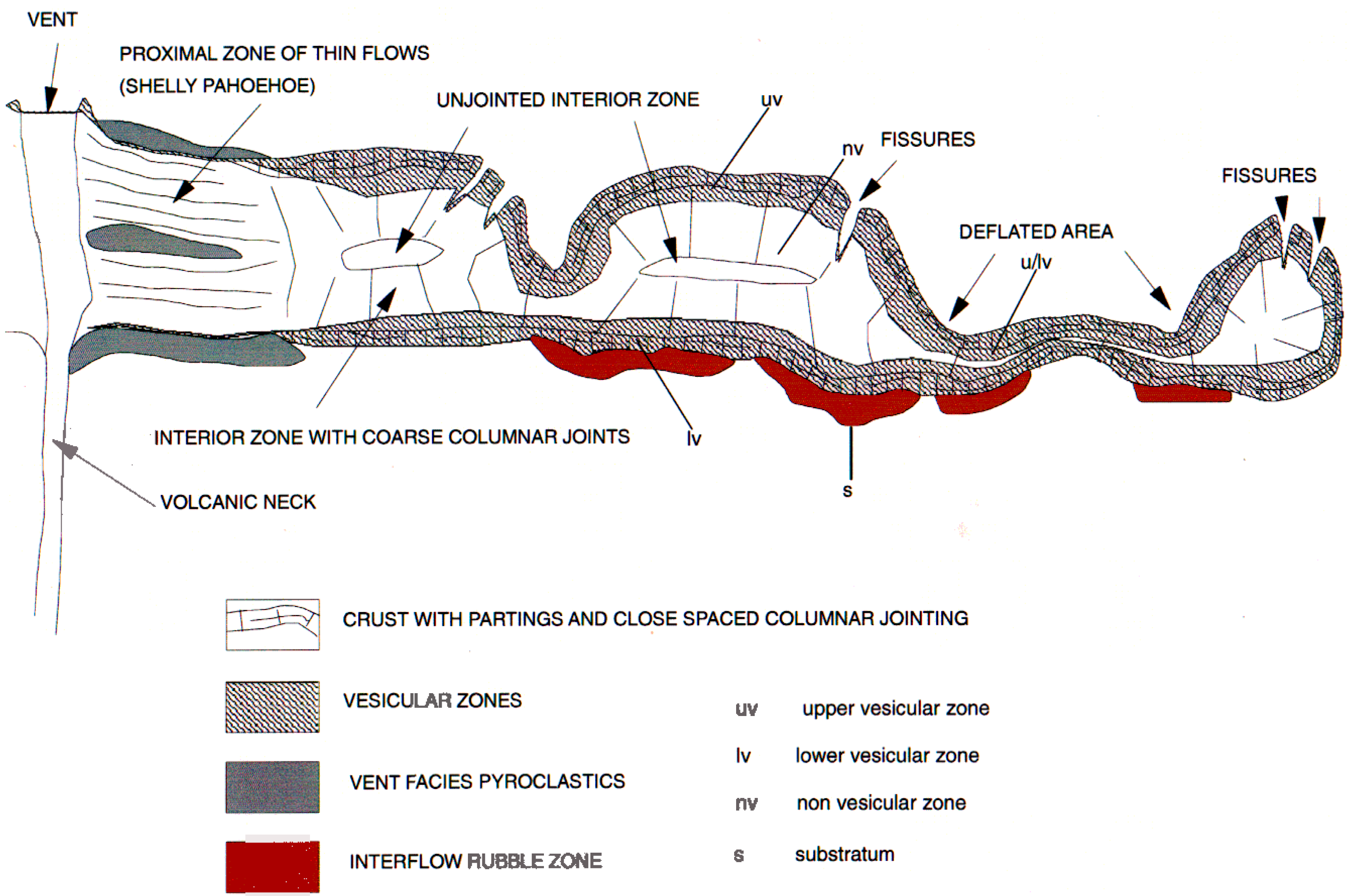

Figure 2-2. Typical vertical cross-section structure of a basalt flow in the ESRP (modified from Knutson et al. 1990).

The vadose zone is a particularly important component of the INEEL hydraulic system. First, the thick vadose zone affords protection to groundwater by acting as a filter and prevents many contaminants from reaching the SRPA. Second, the vadose zone acts as a buffer by providing storage for liquid or dissolved contaminants that have spilled on the ground, have migrated from disposal pits and ponds, or have otherwise been released to the environment. Finally, the vadose zone is important because transport of contaminants through the thick, mostly unsaturated materials can be slow if low-infiltration conditions prevail.

An extensive vadose zone exists at the INEEL and consists of surficial sediments, relatively thin basalt flows, and occasional interbedded sediments (Irving 1993). Surficial sediments include clays, silts, sands, and some gravel. Thick surficial deposits of clays and silts are found in the northern part of the INEEL, but the deposits decrease in thickness to the south, where some basalt is exposed at the topographic surface. Approximately 90% of the vadose zone comprises thick sequences of interfingering basalt flows. These sequences are characterized by large void spaces resulting from fissures, rubble zones, lava tubes, undulatory basalt-flow surfaces, and fractures. Sedimentary interbeds found in the vadose zone consist of sands, silts, and clays and are generally thin and discontinuous. Sediments may be compacted because of original deposition and subsequent overburden pressures.

Perched water at the INEEL forms when a layer of dense basalt or fine sedimentary materials occurs with a hydraulic conductivity that is low enough to restrict vertical movement of the water. Once perched water develops, lateral movement of the water can occur, perhaps by up to hundreds of yards. When perched water accumulates, the hydraulic pressure head increases, resulting in more rapid flow of water through or around the less permeable perching layer. If another low-permeability zone is encountered, perching may occur again. The process can continue, resulting in the formation of several perched water bodies between the land surface and water table. The volume of water contained in perched bodies fluctuates with the amount of recharge available from precipitation, surface water, and anthropogenic sources. Perching behavior tends to slow the downward migration of percolating fluids that may be flowing rapidly under transient, near-saturated conditions through the vadose zone. Historically, perched water has been found beneath INTEC, the RWMC, Argonne National Laboratory–West, and the Test Reactor Area.

The SRPA is defined as the saturated portion of a series of basalt flows and interlayered pyroclastic and sedimentary materials that underlie the ESRP. The lateral boundaries of the SRPA are formed at points of contact with less permeable rocks at the margins of the plain. The total area of the SRPA is estimated at 9,600 mi^2. The SRPA contains numerous, relatively thin basalt flows extending to depths of 3,500 ft below ground surface (bgs). In addition, the SRPA contains sedimentary interbeds that are typically discontinuous. The SRPA has been estimated to hold 8.8E+13 ft^3 of water, which is approximately equivalent to the amount of water contained in Lake Erie, or enough water to cover all of Idaho to a depth of 4 ft (Hackett, Pelton, and Brockway 1986). Water is pumped from the SRPA primarily for human consumption and irrigation (Irving 1993). Compared to such demands, the INEEL's use of less than 1% of the SRPA underflow is minor (Robertson et al. 1974).

SRPA permeability is controlled by the distribution of highly fractured basalt flow tops, interflow zones, lava tubes, fractures, vesicles, and intergranular pore spaces. The variety and degree of interconnected water-bearing zones complicate the direction of groundwater movement locally throughout the SRPA. The permeability of the SRPA varies considerably over short distances, but generally, a series of basalt flows will include several excellent water-bearing zones.

The SRPA is recharged primarily by infiltration from rain and snowfall that occur within the drainage basins surrounding the ESRP and from deep percolation of irrigation water. Annual recharge rates depend on precipitation, especially snowfall. Regional groundwater flows to the south-southwest; but, locally, the flow direction can be affected by recharge from rivers, surface water spreading areas, and heterogeneities in the SRPA. Estimates of flow velocities within the SRPA range from 5 to 20 ft/day (Irving 1993). Flow in the SRPA is primarily through fractures, interflow zones in the basalt, and the highly permeable rubble zones located at flow tops. The SRPA is considered heterogenous and anisotropic (having properties that differ, depending on the direction of measurement) because of the permeability variations that are caused by basalt irregularities, fractures, void spaces, rubble zones, and sedimentary interbeds. The heterogeneity is responsible for the variability in transmissivity (which is a measure of the ability of the aquifer to transmit water) through the SRPA. Transmissivities measured in wells on the INEEL range from 1.1E+00 to 1.2E+07 ft^2/day (Wylie et al. 1995).

2.2 Tank Farm Historical Summary

The tanks located at the tank farm were constructed from 1951 through 1964 and were used to support INTEC SNF reprocessing operations and other incidental liquid waste streams. The tanks include 11 stainless-steel tanks, WM-182 through -190 (300,000-gal) and WM-180 and -181 (318,000-gal), all referred to as 300,000-gal tanks. Each 300,000-gal tank is contained within a concrete vault. The vault base rests on basalt about 45 ft below grade. Section 2.4 provides a detailed physical description of the tanks and their usage over the years. In addition, four inactive 30,000-gal tanks (VES-WM-103 through -106), are situated on concrete pads, also below grade. A conceptual view of these tanks is presented in Figure 2-3.

Primarily, the tank farm handled radioactive liquid waste streams generated during SNF reprocessing. These waste streams were mostly acidic (i.e., nitric acid) (see Section 2.5) and were generated in the first-cycle extraction stage that operated from 1953 to 1992; in second- and third-cycle extraction stages, which operated from 1953 to 1994; and from INTEC plant operations (e.g., off-gas treatment, facility and equipment decontamination, process equipment waste [PEW] evaporation [concentrates or "bottoms"], and laboratory operations). These liquid wastes were stored and treated in the same manner; the liquid waste was accumulated and then transferred to the old Waste Calcining Facility (WCF; CPP-663) for solidification (calcining) until 1981, when the New Waste Calcine Facility (NWCF; CPP-659) began operation (Palmer et al. 1998; Wichmann, Brooks, and Heiser 1996) (see Section 2.2.1).

In 1977, a Dupont Polyolefin 3110 membrane was placed over the surface of the tank farm to prevent water infiltration from the surface. Prior to installing the membrane, the tank farm surface was graded with a 2% slope from the center to the outside edges. The membrane was laid in individual sections, and the connecting seams were affixed with a tar that sealed the seam from any water infiltration. The membrane was drawn up and fitted around aboveground structures and the seams were sealed. Once the membrane was laid, it was smoothed out to eliminate any creases. The design specified that the construction consist of sand-Polyolefin-sand layers followed by gravel to prevent the membrane from blowing away (see Figure 2-4). The membrane was specified at a thickness of 30 mil (minimum) sandwiched between 3 in. (minimum) of sand on the bottom layer, 1.5 in. (minimum) of sand on the top, and followed by 4 in. of gravel.

During the mid 1970s, early 1980s, and early 1990s, the tank farm underwent facility upgrades. In 1977, the waste transfer system was upgraded with the installation of the "C" series valve boxes. The project consisted of installing new valve boxes, refurbishing older valves, rerouting waste piping to the new valve boxes, and consolidating valves within the new valve boxes. The new valve boxes were constructed with drain lines that were designed to drain any leaking liquids to a central location for transfer to the PEW evaporator. Radiation monitors and an enhanced liquid-level monitoring system were also installed in the tank farm during this upgrade. A radiation-monitoring system was installed to detect leaks within valve boxes or other enclosed areas. In 1974, additional liquid-level monitors (electronic radio frequency probes) were installed in each tank to increase the sensitivity of measuring tank volumetric changes to less than ±200 gal.

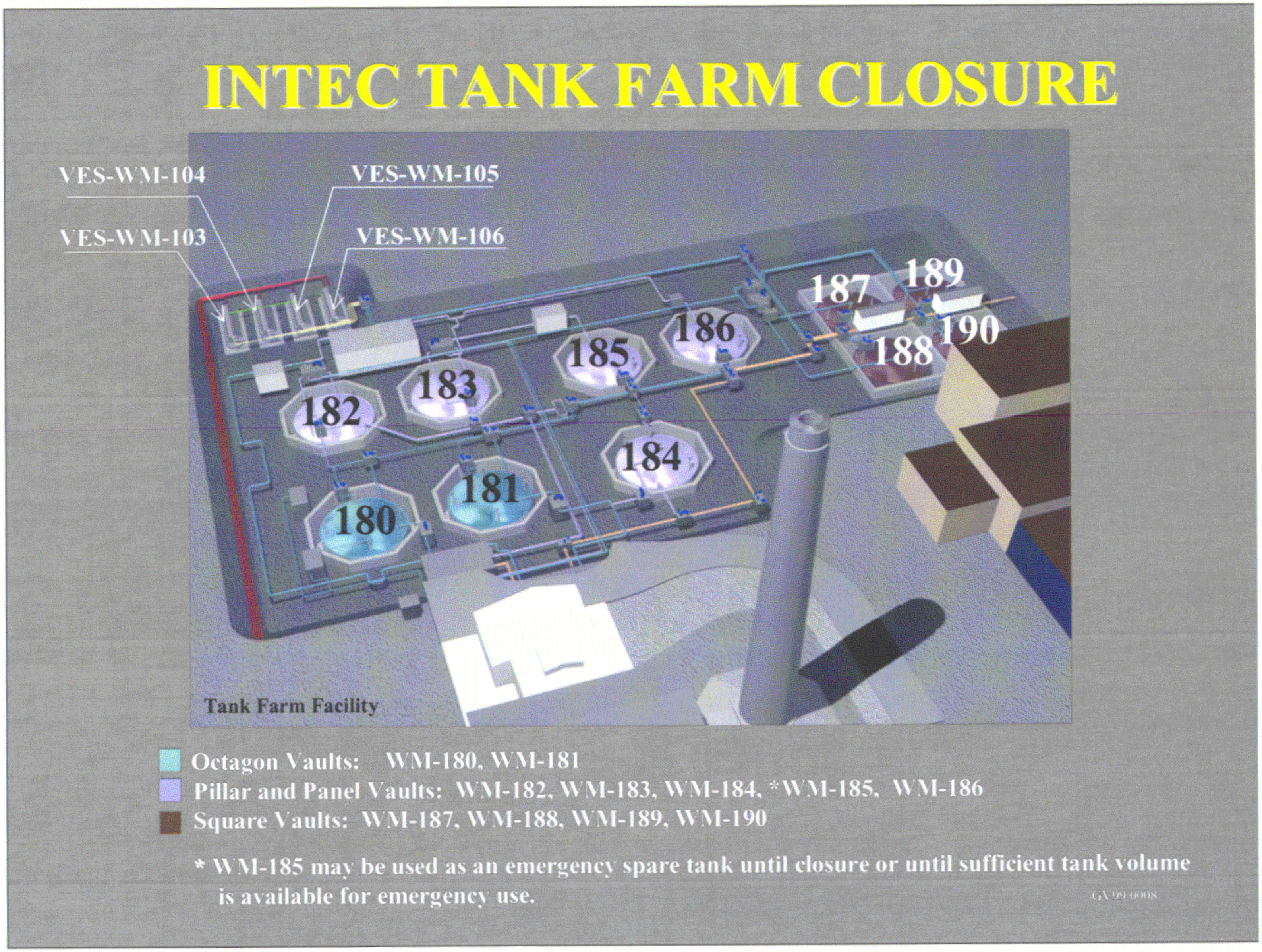

Figure 2-3. Conceptual view of the tank farm looking northeast.

Figure 2-4. Surface membrane liner.

During 1982 and 1983, the Fuel Processing Facility Upgrade Project was undertaken to construct a concrete vault to house waste tanks VES-WL-132 and VES-WL-133 east of the PEW system (see Figure 2-5). The project also provided upgrades to various valve boxes. Excavation was performed to bedrock (approximately 40 to 45 ft) and encompassed site CPP-33 and the northern and eastern edges of CPP-27. Review of site construction photos (Section 3.1.5, Figures 3-27 through 3-29) indicates that the excavation closely adhered to the excavation plan (INTEC Drawing 162316). In this same time frame, a separate project was underway to replace the process lines from CPP-601 to CPP-604. Excavation was performed to the top of the CPP-604 tank vault encompassing sites CPP-20 and CPP-25 (see Section 3.1.9, Section 3.1.10, and Figures 3-36 through 3-39).

The 1992 High Level Waste Tank Farm Upgrade (HLWTFU) project replaced valves in valve boxes with new valves that could be repaired remotely using extension tools, thus reducing worker radiation exposure. The carbon-steel pressure relief discharge header connecting each tank farm tank to the exhaust stack was also replaced due to corrosion holes in the header. The header was disconnected from each tank condenser pit, capped, and abandoned in place. A new stainless-steel pressure-relief discharge line was connected from each tank condenser pit to a new header pipe leading to the atmospheric protection "vent tunnel" ventilation system. As part of this upgrade project, remaining pipelines with inadequate secondary containment were replaced (capped and abandoned in place), and other unnecessary piping was eliminated as needed. The piping north of CPP-604 that was a part of the 1992 upgrade is shown in Figure 2-6 (see also Section 3).

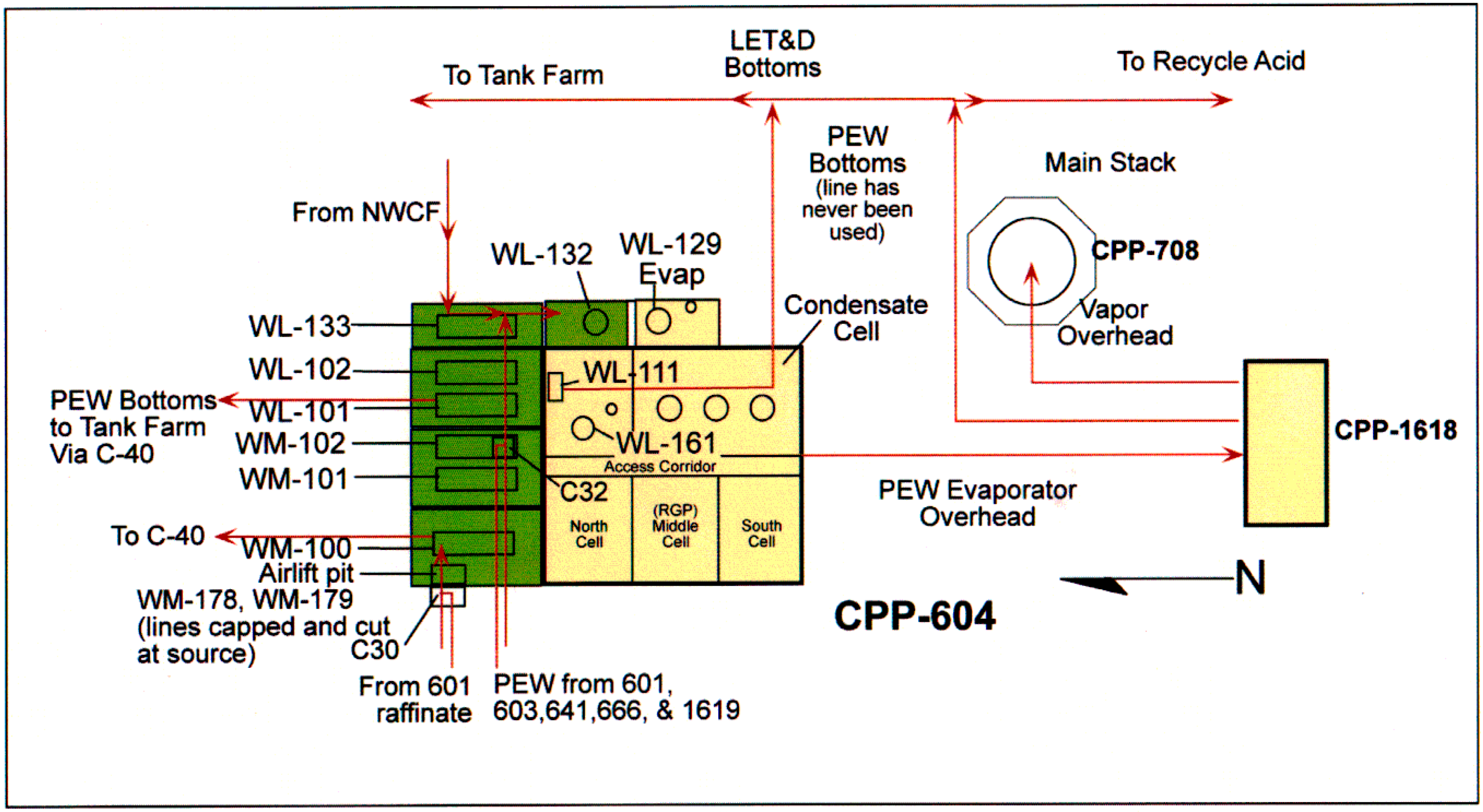

Figure 2-5. Schematic showing the PEW system looking east, including the main transfer lines.

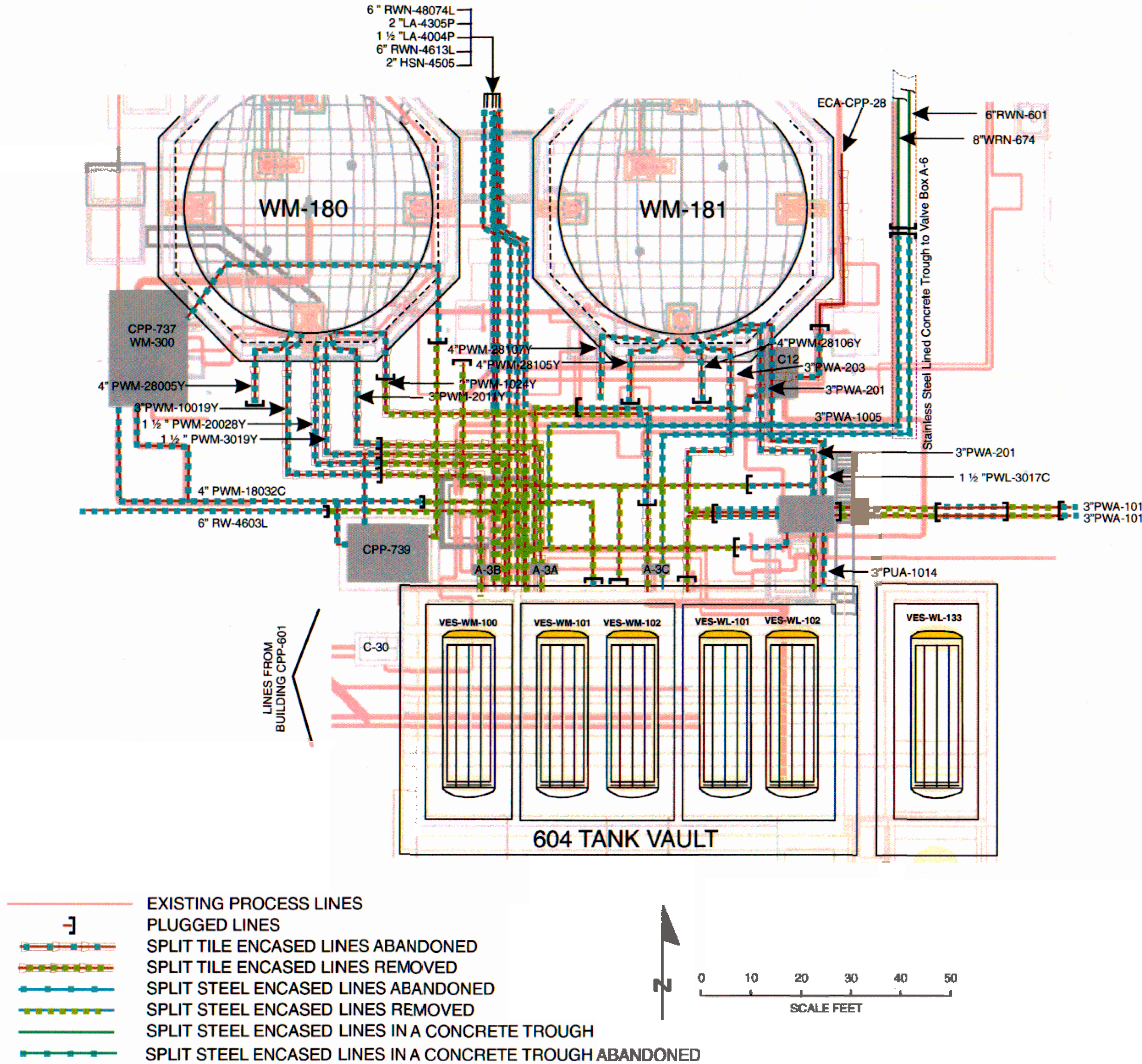

Figure 2-6. Upgrade of piping north of CPP-604.

In April 1992, the DOE called for the shutdown of SNF reprocessing facilities at INTEC. Since that time, no more liquid waste from SNF reprocessing has been generated, although decontamination and incidental activities have created additional liquid waste.

In addition, under the terms of a 1992 Consent Order (DOE-ID 1992) and subsequent modifications discussed in Section 1, DOE Idaho was required to either permanently stop using the tanks or bring them into compliance with secondary containment requirements. DOE Idaho decided not bring them into compliance and to close the eleven 300,000-gal and the four 30,000-gal underground tanks within the tank farm by 2012. This decision was made because (1) reprocessing had been terminated, (2) the tanks could not be certified to meet RCRA secondary containment requirements,[a] and (3) the high radiation fields within the tank farm greatly impede the ability to bring the tanks into compliance. The tanks have never leaked, and their estimated remaining life (970 years) far exceeds their remaining use (Palmer et al. 1998) (see Section 2.3).

The 1995 *Settlement Agreement* (DOE 1995) required all of the tank farm's non-SBW[b] to be calcined by June 30, 1998 (which was completed by February 1998) and all of the tank farm's SBW[c] to be treated by December 31, 2012. However, because the calciner system in the NWCF building (CPP-569) is undergoing HWMA/RCRA closure, the remaining SBW at the tank farm has no identified treatment (see Figure 2-7). The SBW treatment or series of treatments will be selected and implemented based on the HLW&FD FEIS (DOE-ID 2002a) ROD.

2.2.1 Liquid Waste Calcination

From 1963 until June 2000, liquid waste stored at the tank farm was converted to granular solids using a process known as calcination. The liquid in the radioactive waste was evaporated, and the dissolved metals and fission products were converted to metal salts and oxides. Each granule is about 0.3 to 0.7 mm in size. The SBW required special handling in order to be calcined; it was concentrated in the liquid waste evaporator or blended with other liquid waste. This was done to (1) prevent the sodium, which was in high concentration, from forming alkali compounds that would melt and cause the calciner's fluidized bed to agglomerate and (2) prevent high levels of potassium and manganese that would clog the calciner (Palmer et al. 1998; Wichmann, Brooks, and Heiser 1996; WINCO 1986a). The solids were then transferred to stainless-steel bins collectively called the Calcined Solids Storage Facility (CSSF) for

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a. The concrete vaults containing the 300,000-gal tanks have no access; therefore, they cannot be readily inspected to certify either compliance with RCRA secondary containment requirements or current seismic standards.

b. Non-SBW is high-level radioactive waste. At INTEC, this waste is defined as first-cycle extraction raffinates, which are from spent fuel reprocessing.

c. SBW is second- and third-cycle extraction raffinates and other liquid waste generated from INTEC plant operations (e.g., off-gas treatment, facility and equipment decontamination, PEW evaporator concentrates ["bottoms"], and laboratory operations).

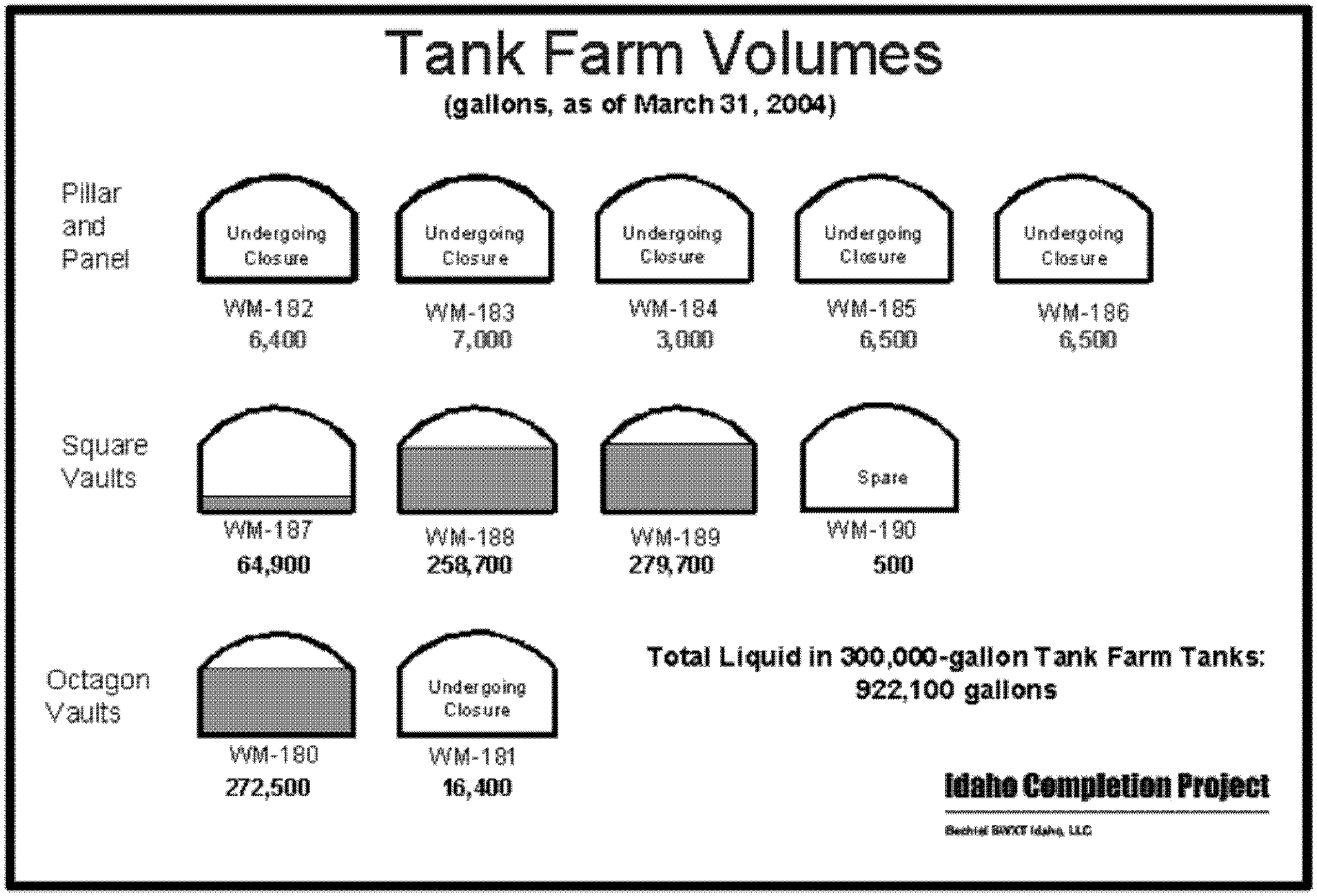

Figure 2-7. March 2004 tank farm waste tank volumes (300,000-gal tanks) (BBWI 2004).

interim storage. Calcination typically reduced the volume of non-SBW by two to 10 times[d] and reduced the volume of SBW by two to four times. The WCF operated from 1963 until 1981 calcining the liquid waste stored at the tank farm. Closure of the WCF began in 1998 and was completed in 1999. From September 1982 until June 2000, the calcination was performed at the NWCF. The calciner system in the NWCF building (CPP-659) is currently undergoing HWMA/RCRA closure. The liquid SBW will remain in the tanks at the tank farm until a treatment technology is selected and implemented based on the HLW&FD FEIS (DOE-ID 2002a) ROD.

2.2.2 Process Equipment Waste

At one time, three 18,000-gal PEW tanks (WM-100 through -102, as shown on Figure 2-5) located within the Waste Treatment Building (CPP-604) and the associated valve boxes, encasements, and piping (LMITCO 1998, 1999b) were considered part of the tank farm system. These three tanks are no longer considered part of the tank farm system. DOE Idaho anticipates that the PEW system will continue operating to support INTEC after the tank farm is closed. Waste solutions from NWCF calciner closure activities will be sent to the PEW system. However, once the tank farm is closed, the PEW and the concentrates (i.e., "bottoms") from the Liquid Effluent Treatment and Disposal Facility (CPP-1618) will not be returned to the tank farm. Instead, another storage/treatment facility is anticipated to be available. The three PEW tanks, along with five support tanks (WL-101, -102, -132, -133, and a new tank, WL-111) (Figure 2-5), are being permitted as part of the PEW system (LMITCO 1999b). The PEW system will be closed under RCRA when the system is no longer useful or reaches the end of its life cycle.

2.3 Current Mission of INTEC and the Tank Farm

The current DOE Idaho mission for INTEC includes management and storage of SNF, treatment and storage of HLW (solidified), liquid radioactive waste (SBW), and newly generated liquid (low-level) waste (NGLW).

The tank farm provides interim storage for past and present SBW. The SBW includes (1) second- and third-cycle raffinates generated during former INTEC SNF operations and (2) decontamination waste streams from INTEC operations (e.g., laboratories, the fuel basins, and plant closure activities). SBW from past operations is stored in the 300,000-gal tanks with the NGLW. Currently, SBW and NGLW waste streams are not segregated. The NGLW (10 CFR 61.55) includes INTEC waste streams from the fuel storage basins, water run-off, evaporation and off-gas cleanup operations, analytical laboratories, and equipment decontamination. As long as INTEC is in operation, newly generated liquid SBW will be generated by ongoing processes such as decontamination and off-gas cleanup.

The total volume of SBW in storage at the tank farm at any given time is dependent on the quantity and type of work done at INTEC. The SBW is sent either directly to the SBW tanks or is sent through the PEW evaporator first and then to the tanks. Reduction of the liquid waste volume is accomplished through continued evaporation with the PEW evaporator. Figure 2-7 illustrates (in blue) recent tank farm volumes.

2.3.1 Closure of the Tank Farm System

The tank farm systems are being closed in accordance with a 1992 Consent Order (DOE-ID 1992) and the second modification to the Consent Order (DOE-ID 1998a). The closure will follow the HWMA/RCRA closure performance standards identified in IDEQ-approved HWMA/RCRA closure

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d. Interdepartmental correspondence from W. B. Palmer to J. T. Beck, "Removing HLW from the Tank Farm," WBP-07-98, Lockheed Martin Idaho Technologies Company, December 11, 1998.

plans. These closure plans recognize that the contaminated soils in the tank farm are undergoing investigation by the CERCLA program, and the plans will not duplicate the efforts of the CERCLA investigation and any follow-on remediation actions for the contaminated soils. The closure plans must also meet the requirements of DOE O 435.1, "Radioactive Waste Management" (see Section 1 for regulatory discussion on tank closure).

The strategy that DOE Idaho provided to IDEQ identified the general approach for closure of the tank farm system. The planned approach begins with removing the waste from the tanks and ancillary system, decontaminating the system components, and sampling the decontamination residuals. The sample data from the decontamination rinsate will be compared to site-specific action levels.

When all of the tanks are decontaminated (tank and ancillaries), final Tank Farm Facility closure and closure certification will occur. The Tank Farm Facility will be closed as an HWMA/RCRA interim status unit (IDAPA 58.01.05.009 [40 CFR 265]). The closed system will then be evaluated under OU 3-14. Upon meeting the performance criteria for waste removal and system decontamination, documentation will be provided to IDEQ certifying the performance of partial closure.

Phase 1 of the tank farm closure began in 2001 with pillar and panel vaulted tanks WM-182 and -183 (DOE-ID 2001a). In 2003, Phase 2 closure of pillar and panel vaulted tanks WM-184, -185, and -186 began. The waste (heel) has been removed from tanks WM-182, -183, -184, -185, and -186. Preliminary analysis calculated risk values assuming the tank residuals after cleaning would be 1 in. or less. Experience has shown the tank residuals remaining after cleaning to be no more than 1/8 in.[e] Figure 2-7 shows March 2004 volumes remaining in the tanks.

Preliminary sample results indicate tanks WM-182 and -183 have been cleaned successfully and meet the performance criteria.[f] The ancillary system and system components are currently being cleaned. Phase 1 will include isolating the closed system to eliminate any future inflow to the tanks, ancillary equipment, or secondary containment. The approved closure plan for WM-182 and -183 (DOE-ID 2001a) calls for using grout to isolate systems and fill void spaces. However, grouting was suspended due to legal uncertainty arising from litigation concerning certain reprocessing wastes under DOE O 435.1. Per the closure plan (DOE-ID 2001a), Phase 1 will not be completed until the tanks are grouted. In the interim, Phase 2 cleaning of pillar and panel vaulted tanks WM-184, -185, and -186 was performed. Cleaning of tank WM-181 began in April 2004.

Information pertaining to tank closure can be found in the following documents:

- *Idaho Hazardous Waste Management Act/Resource Conservation and Recovery Act Closure Plan for Idaho Nuclear Technology and Engineering Center Tanks WM-182 and WM-183*, DOE/ID-10802, November 2001. (DOE-ID 2001a)

- *Tier 1 Closure Plan for Idaho Nuclear Technology and Engineering Center Tank Farm Facility at INEEL*, DOE/ID-10975, March 2002. (DOE-ID 2002b)

- *Idaho Hazardous Waste Management Act/Resource Conservation and Recovery Act Closure Plan for Idaho Nuclear Technology and Engineering Center Tanks WM-184, WM-185, and WM-186*, DOE/ID-11067, Rev. 2, March 2004. (DOE-ID 2004b)

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e. Personal communication between L. Cahn, Bechtel BWXT Idaho, LLC, and K. Quigley, Bechtel BWXT Idaho, LLC, April 26, 2004.

f. Preliminary sample results for WM-182 and -183 will be reported in a data quality assessment report for each tank. Comparison of the sample results with the performance criteria will be documented in the Tier 2 closure plan for Phase 1.

Two issues must be resolved before complete closure of the tank farm can be accomplished. The first issue relates to pending resolution of litigation concerning DOE O 435.1. The second issue is the selection of a technology to treat the remaining liquid radioactive waste (SBW) stored in the tank farm. At this time, the treatment is undecided and remains under review. Until a decision is made and a treatment facility is built and operational, the remaining tanks containing liquid SBW (see Figure 2-7) cannot be cleaned.

2.3.2 Tank Farm Soil Remedial Investigation

The rationale for this Tank Farm Soil Remedial Investigation/Feasibility Study Work Plan and the RI/FS study tasks are presented in Sections 5 and 6, respectively.

2.4 Physical Description of Tanks

The design characteristics and specific past use of the individual underground storage tanks at the tank farm are presented in this section. The tanks include

- Eleven active tanks with a capacity of about 300,000 gal each. The tanks include nine 300,000-gal tanks (WM-182 through -190) and two 318,000-gal tanks (WM-180 and -181). These 11 tanks are referred to collectively as the 300,000-gal tanks.

- Four inactive tanks with a capacity of 31,000 gal each (VES-WM-103 through -106). As shown in Figure 2-5, the four tanks are located north of WM-182. These four tanks are referred to collectively as the 30,000-gal tanks.

2.4.1 300,000-gal Tank Design

The 300,000-gal tanks are similar in design. Each has a diameter of 50 ft, has an overall height of 30 to 32 ft, and is contained in an unlined underground concrete vault. The vault floors are about 45 ft below grade. The three basic designs of the vaults are described below:

- Monolithic octagon. The two oldest tanks at the tank farm (WM-180 and -181) were constructed from 1951 to 1953 and are contained in poured-in-place, monolithic, octagonal, concrete vaults. A photograph of the vault for WM-180 is provided in Figure 2-8.

- Pillar and panel octagon. The five tanks contained in vaults of pillar and panel construction, WM-182 through -186, were constructed from 1954 to 1957. A photograph of the vault for tank WM-182 is provided in Figure 2-9. A photograph of the vault and dome of tank WM-185, showing the pre-cast concrete beams and concrete risers on top, is provided in Figure 2-10. Also octagonal, the pillar and panel vaults are of prefabricated construction. The pillar and panel design is considered the least structurally sound of the three basic designs; therefore, tanks with this design must be closed first, with the exception of tank WM-185, which has been designated as an emergency spare.

- Monolithic square. The four tanks contained in reinforced, poured-in-place, monolithic-square, four-sectioned (or "four-pack"), concrete vaults (WM-187 through -190) were constructed from 1959 to 1964 (see Figure 2-11).

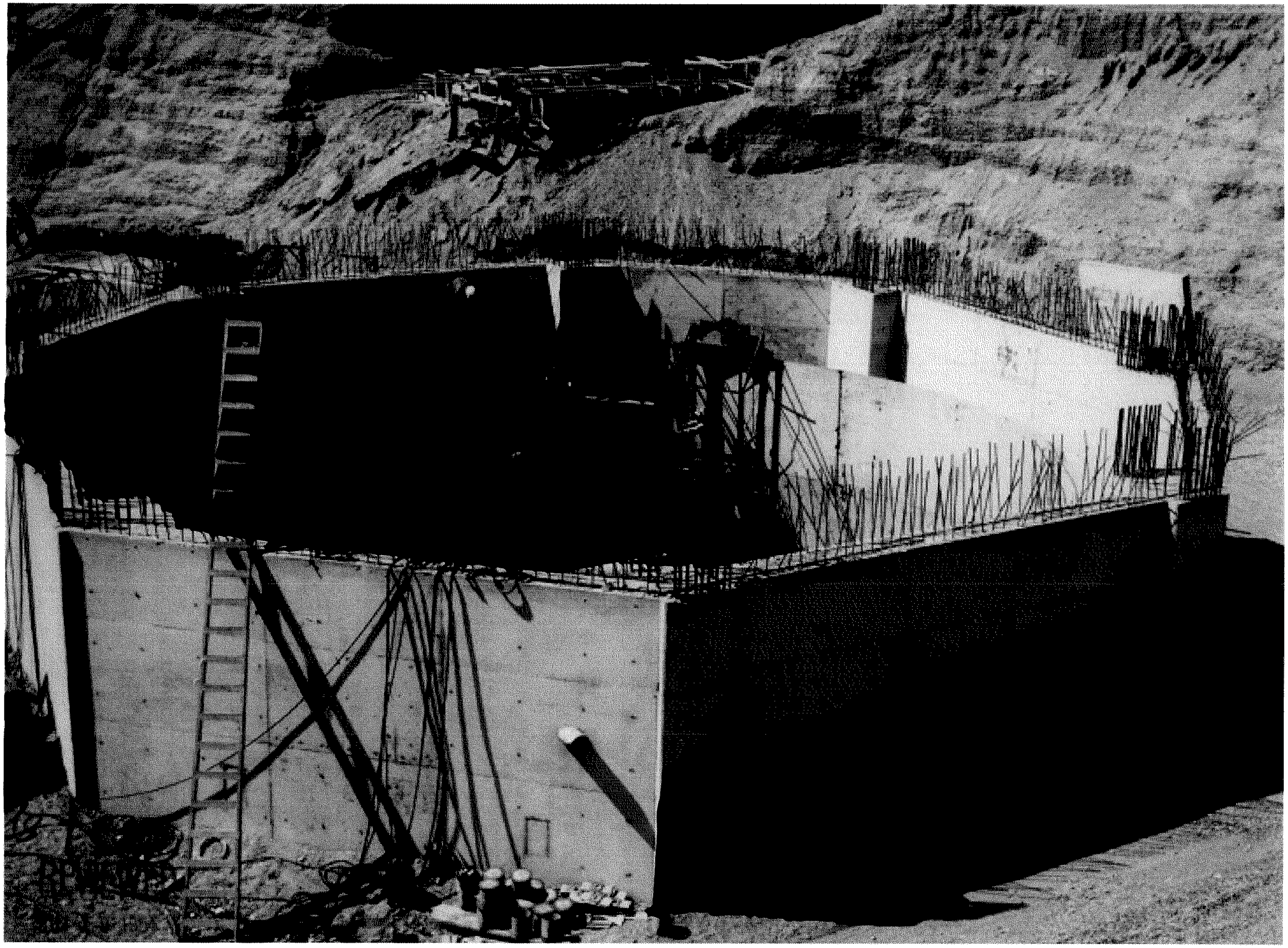

Figure 2-8. Monolithic octagonal vault for WM-180.

Figure 2-9. Pillar and panel octagonal vault for WM-182.